What is claimed is:

1. A shock-absorber unit for arresting motion of a moving mass in a vacuum environment, the shock-absorber unit comprising:

a shock absorber having a proximal end and having a distal end extending toward the mass so as to be contacted by the mass moving with a momentum directed toward the shock absorber, the shock absorber being configured to absorb the momentum and thus arrest motion of the mass as the mass, moving toward the shock absorber, makes contact with the distal end; and

isolation means for isolating the shock absorber from the vacuum environment.

2. The shock-absorber unit of claim 1, wherein:

the vacuum environment is established in a vacuum chamber; and

the proximal end of the shock absorber is affixed to a wall of the vacuum chamber.

3. The shock-absorber unit of claim 2, wherein:

the wall of the vacuum chamber defines a through-hole; and

the proximal end of the shock absorber extends through the through-hole to the inside of the vacuum chamber from outside the vacuum chamber.

4. The shock-absorber unit of claim 1, wherein:

the distal end of the shock absorber is configured to exhibit movement in a motion direction of the mass whenever the shock absorber is absorbing the momentum of the mass; and

the isolation means moves with the distal end of the shock absorber whenever the shock absorber is absorbing the momentum of the mass.

5. The shock-absorber unit of claim 4, wherein the isolation means comprises a bellows that is axially arranged and that exhibits compression in the motion direction accompanying a corresponding motion of the distal end.

6. The shock-absorber unit of claim 5, wherein the bellows is attached in a sealing manner to the shock absorber to isolate at least a portion of the shock absorber, including the distal end, from the vacuum environment.

7. The shock-absorber unit of claim 5, wherein the bellows has a distal end contacted by the distal end of the shock absorber.

8. The shock-absorber unit of claim 7, further comprising extension-limitation means connected to the distal end of the bellows and serving to impose a maximum allowable extension of the distal end of the shock absorber.

9. The shock-absorber unit of claim 4, wherein:

the isolation means covers, within an interior space defined by the isolation means, at least a portion of the shock absorber including the distal end; and

the interior space is in communication with an atmosphere external to the vacuum environment.

10. The shock-absorber unit of claim 9, wherein the atmosphere external to the vacuum environment has a subatmospheric pressure.

11. The shock-absorber unit of claim 10, further comprising an exhaust pump, fluidically connected to the interior space, that establishes the subatmospheric pressure.

12. The shock-absorber unit of claim 4, wherein:

the isolation means covers, within an interior space defined by the isolation means, at least a portion of the shock absorber including the distal end; and

the interior space is at a vacuum level substantially the same as the vacuum level in the vacuum environment.

13. The shock-absorber unit of claim 4, further comprising extension-limitation means connected to the distal end and serving to impose a maximum allowable extension of the distal end.

14. The shock-absorber of claim 4, wherein:

the distal end comprises a movable shaft having an outside diameter and axially extending toward the mass; and

the isolation means comprises a stationary head cover providing a dynamic seal to the shaft and isolating at least a portion of the shock absorber from the vacuum environment.

15. The shock-absorber unit of claim 1, wherein:

the shock absorber contains a liquid that facilitates shock absorption by the shock absorber; and

the isolation means comprises a sheath forming a seal preventing entry of the liquid, that has escaped from the shock absorber, into the vacuum environment.

16. The shock-absorber unit of claim 15, wherein the liquid is a vacuum oil.

17. The shock-absorber unit of claim 15, wherein the shock absorber comprises a hydraulic cylinder, including (i) a housing containing the liquid and having

a distal end and a proximal end, the proximal end being located at the proximal end of the shock absorber, and (ii) a piston rod extending from inside the housing through a dynamic seal in the housing to the distal end of the shock absorber.

18. The shock-absorber unit of claim 17, wherein the sheath comprises a bellows having a proximal end sealingly attached to the housing and a closed distal end to which a distal end of the piston rod, situated inside the bellows, extends and contacts.

19. The shock-absorber unit of claim 18, further comprising means for maintaining contact of the distal end of the piston rod with the closed distal end of the bellows.

20. The shock-absorber unit of claim 19, wherein the means for maintaining contact comprises a spring urging movement of the piston rod relative to the housing.

21. The shock-absorber unit of claim 17, wherein the distal end of the bellows is sealingly attached to a disk having an inside surface contacted by the distal end of the piston rod and an outside surface to which a bumper is mounted, the bumper being contactable by the movable mass moving toward the bumper.

22. The shock-absorber unit of claim 21, further comprising extension-limitation means connected to the distal end and serving to impose a maximum allowable extension of the distal end.

23. The shock-absorber unit of claim 22, wherein the extension-limitation means comprises at least one cable connected from the disk to the housing outside the bellows.

24. The shock-absorber unit of claim 1, further comprising:

a fixed base to which the proximal end of the shock absorber is mounted; and

a contact member contacted by the distal end of the shock absorber, the contact member being situated and configured to be contacted by the mass moving toward the shock absorber.

25. The shock-absorber unit of claim 24, wherein the isolation means comprises a sheath extending between the fixed base and the contact member.

26. The shock-absorber unit of claim 25, further comprising a compression-limitation means extending between the fixed base and the contact member, the extension-limitation means imposing a maximum allowable distance of the contact member from the fixed base.

27. A shock-absorber unit for arresting motion of a moving mass in a vacuum environment, the shock-absorber unit comprising a shock absorber including a gas-filled portion and a piston situated and movable within the gas-filled portion and separating the gas-filled portion from a non-gas-filled portion, and a piston rod extending from the piston through the non-gas-filled portion to outside the gas-filled and non-gas-filled portions and toward the mass so as to be contacted by the mass moving with a momentum toward the shock absorber, wherein contact of the mass with the piston rod causes movement of the piston and a consequent reduction in volume of the gas-filled portion.

28. The shock-absorber unit of claim 27, wherein the gas-filled portion and non-gas-filled portion are respective portions of a gas cylinder having an axis parallel to a momentum direction of the mass.

29. The shock-absorber unit of claim 27, further comprising:

a vent space;

a conduit connecting the vent space to the gas-filled portion; and

a flow-restrictor situated in the conduit and configured to restrict a flow rate of gas from the gas-filled portion to the vent space whenever movement of the piston is reducing the volume of the gas-filled portion.

30. The shock-absorber unit of claim 29, wherein:

the vacuum environment is established in a vacuum chamber; and

the vent space is located outside the vacuum chamber.

31. A shock-absorber unit for arresting motion of a moving mass in a vacuum environment, the shock-absorber unit comprising:

a contact portion situated and configured to contact the moving mass as the mass moves with a momentum in a movement direction toward the contact portion;

a movement guide situated relative to the contact portion and configured to guide movement of the contact portion as the shock-absorber unit absorbs the momentum of the mass; and

a compliant member situated between the contact portion and a rigid stop and configured to exhibit a compliant deformation, in response to the mass contacting the contact portion, that provides resistance to the motion of the contacting mass.

32. The shock-absorber unit of claim 31, wherein the compliant member comprises a compliant rod having an axis oriented parallel to the movement direction of the mass.

33. The shock-absorber unit of claim 32, wherein the compliant member further comprises a compression spring urging restoration of a pre-impact length of the compliant rod, relative to the rigid stop.

34. The shock-absorber unit of claim 31, wherein the contact portion and compliant member are situated and configured to move, when the moving mass contacts the contact portion, in a direction parallel to the direction of the momentum of the moving mass.

35. The shock-absorber unit of claim 31, wherein the compliant member is made of an elastomer selected from the group consisting of fluororesins, polyimides, and polyether ether ketones.

36. A shock-absorber unit for arresting motion of a moving mass in a vacuum environment, the shock-absorber unit comprising a hydraulic cylinder having a housing and a piston rod, the piston rod having a distal end situated and configured to receive an impact of the mass moving in a movement direction, the hydraulic cylinder containing a low-vapor-pressure oil used to arrest the movement of the mass.

37. A vacuum chamber, comprising:

a vessel having walls collectively defining an interior space of the vacuum chamber;

a movable mass contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the mass in the vacuum chamber, the shock-absorber unit comprising (i) a shock absorber having a proximal end coupled to a wall and having a distal end extending toward the mass so as to be contacted by the mass moving with a momentum directed toward the shock absorber, the shock absorber

being configured to absorb the momentum and thus arrest motion of the mass as the mass, moving toward the shock absorber, makes contact with the distal end; and (ii) isolation means for isolating the shock absorber from the vacuum environment.

38. A vacuum chamber, comprising:

a vessel having walls collectively defining an interior space of the vacuum chamber;

a movable mass contained within the vacuum chamber; and

a shock-absorber unit coupled to a wall of the vacuum chamber for arresting motion of the mass in the vacuum chamber, the shock-absorber unit comprising (i) a shock absorber including a gas-filled portion, (ii) a piston situated and movable within the gas-filled portion and separating the gas-filled portion from a non-gas-filled portion, and (iii) a piston rod extending from the piston through the non-gas-filled portion to outside the gas-filled and non-gas-filled portions and toward the mass so as to be contacted by the mass moving with a momentum toward the shock absorber, wherein contact of the mass with the piston rod causes movement of the piston and a consequent reduction in volume of the gas-filled portion.

39. A vacuum chamber, comprising:

a vessel having walls collectively defining an interior space of the vacuum chamber;

a movable mass contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the mass in the vacuum chamber, the shock-absorber unit comprising (i) a contact portion situated and configured to contact the moving mass as the mass moves with a momentum in a movement direction toward the contact portion, (ii) a movement guide situated relative to the contact portion and configured to guide movement of the contact portion as the shock-absorber unit

absorbs the momentum of the mass, and (iii) a compliant member situated between the contact portion and a rigid stop and configured to exhibit a compliant deformation, in response to the mass contacting the contact portion, that provides resistance to the motion of the contacting mass.

40. A vacuum chamber, comprising:

a vessel having walls collectively defining an interior space of the vacuum chamber;

a movable mass contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the mass in the vacuum chamber, the shock-absorber unit comprising a hydraulic cylinder having a housing and a piston rod, the piston rod having a distal end situated and configured to receive an impact of the mass moving in a movement direction, the hydraulic cylinder containing a low-vapor-pressure oil used to arrest the movement of the mass.

41. A microlithography system, comprising:

a vacuum chamber establishing a vacuum environment for performing microlithography;

a movable stage contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the stage in the vacuum chamber, the shock-absorber unit comprising (i) a shock absorber having a proximal end coupled to a wall of the vacuum chamber and having a distal end extending toward the stage so as to be contacted by the stage moving with a momentum directed toward the shock absorber, the shock absorber being configured to absorb the momentum and thus arrest motion of the stage as the stage, moving toward the shock absorber, makes contact with the distal end; and (ii) isolation means for isolating the shock absorber from the vacuum environment.

42. The microlithography system of claim 41, wherein the stage is a reticle stage or a substrate stage.

43. A microlithography system, comprising:

a vacuum chamber establishing a vacuum environment for performing microlithography;

a movable stage contained within the vacuum chamber; and

a shock-absorber unit coupled to a wall of the vacuum chamber for arresting motion of the stage in the vacuum chamber, the shock-absorber unit comprising (i) a shock absorber including a gas-filled portion, (ii) a piston situated and movable within the gas-filled portion and separating the gas-filled portion from a non-gas-filled portion, and (iii) a piston rod extending from the piston through the non-gas-filled portion to outside the gas-filled and non-gas-filled portions and toward the stage so as to be contacted by the stage moving with a momentum toward the shock absorber, wherein contact of the stage with the piston rod causes movement of the piston and a consequent reduction in volume of the gas-filled portion.

44. The microlithography system of claim 43, wherein the stage is a reticle stage or a substrate stage.

45. A microlithography system, comprising:

a vacuum chamber establishing a vacuum environment for performing microlithography;

a movable stage contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the stage in the vacuum chamber, the shock-absorber unit comprising (i) a contact portion situated and configured to contact the moving stage as the stage moves with a momentum in a movement direction

toward the contact portion, (ii) a movement guide situated relative to the contact portion and configured to guide movement of the contact portion as the shock-absorber unit absorbs the momentum of the stage, and (iii) a compliant member situated between the contact portion and a rigid stop and configured to exhibit a compliant deformation, in response to the stage contacting the contact portion, that provides resistance to the motion of the contacting stage.

46. The microlithography system of claim 45, wherein the stage is a reticle stage or a substrate stage.

47. A microlithography system, comprising:

a vacuum chamber establishing a vacuum environment for performing microlithography;

a movable stage contained within the vacuum chamber; and

a shock-absorber unit for arresting motion of the stage in the vacuum chamber, the shock-absorber unit comprising a hydraulic cylinder having a housing and a piston rod, the piston rod having a distal end situated and configured to receive an impact of the stage moving in a movement direction, the hydraulic cylinder containing a low-vapor-pressure oil used to arrest the movement of the stage.

48. The microlithography system of claim 47, wherein the stage is a reticle stage or a substrate stage.

49. A microlithography system, comprising:

a vacuum chamber establishing a vacuum environment for performing microlithography;

a movable stage contained within the vacuum chamber; and

a shock-absorber unit mounted outside the vacuum chamber and extending into the chamber, the shock-absorber unit being configured to arrest a runaway motion of the stage inside the vacuum chamber.

50. The microlithography system of claim 49, wherein the stage is a reticle stage or a substrate stage.